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H01M 2/30

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(56) Documents cited
GB 1536143 A GB 0877298 A US 4035552 A
US 4028478 A US 4025696 A US 3939011 A

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UK CL (Edition J) H1B
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(54) Cell

(57) A primary cell has a container comprising a metal can (18) closed by a plastic disc (16) through which a current collector (17) extends. If the pressure inside the container rises to an excessive value, the plastics disc is deformed and the electrical circuit through the cell is opened.

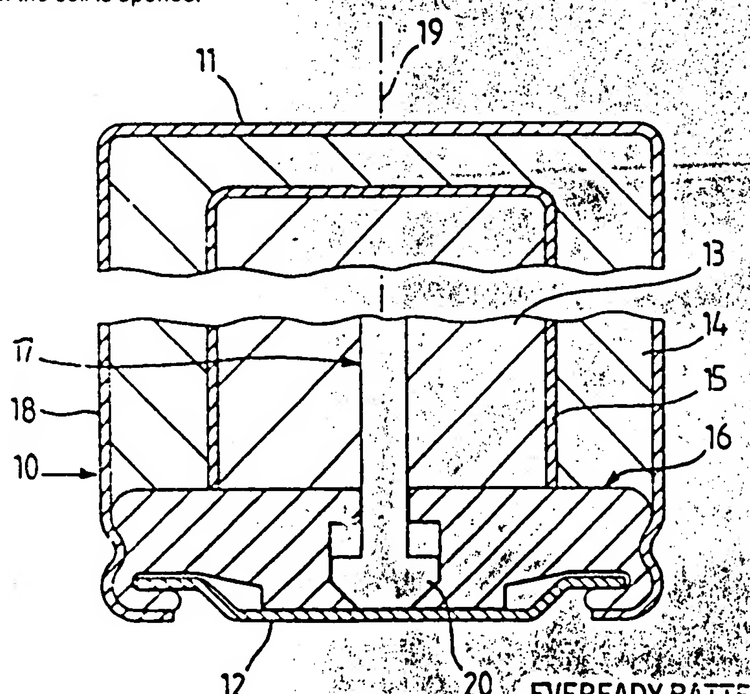

FIG 1

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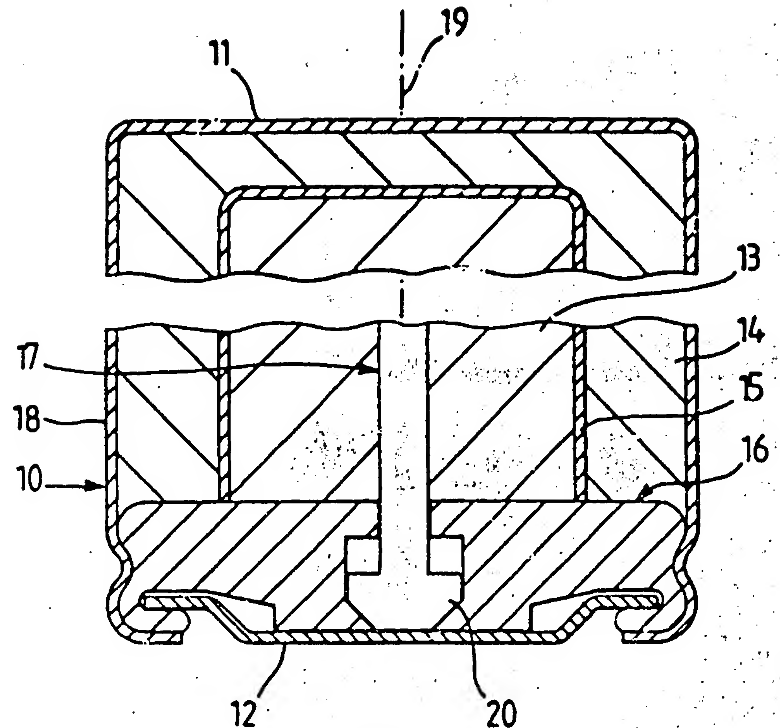
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FIG 1

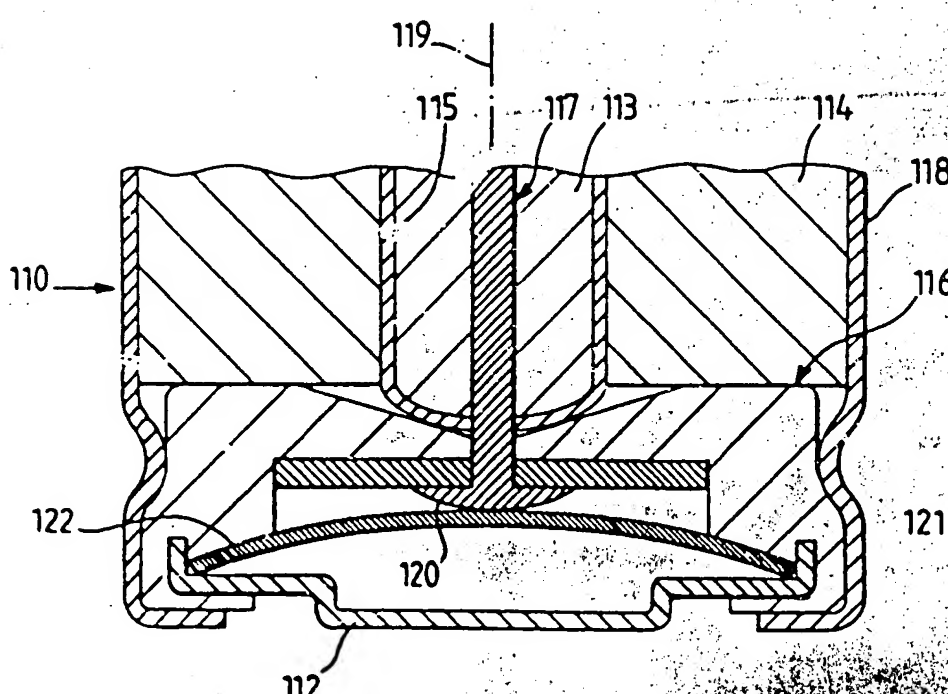
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FIG 2

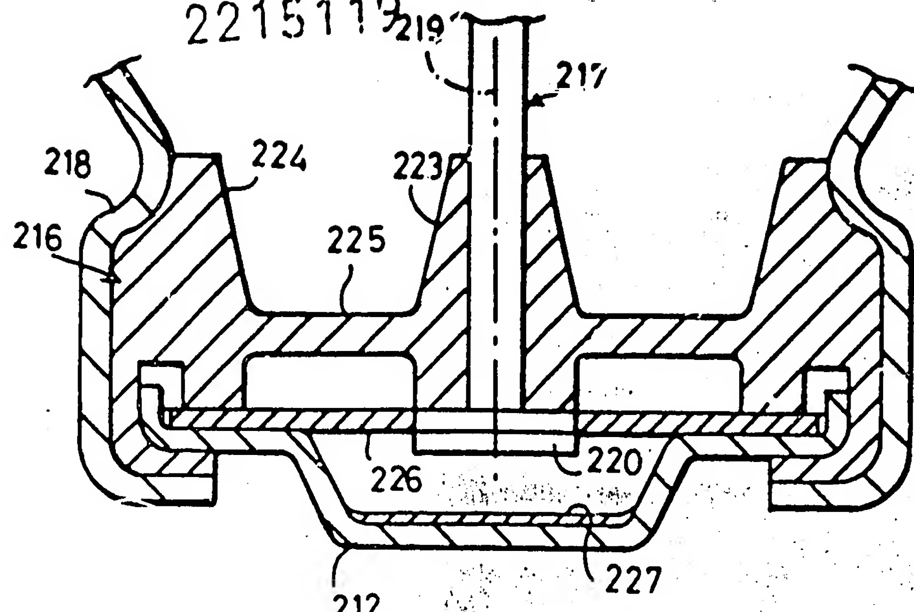
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FIG 3

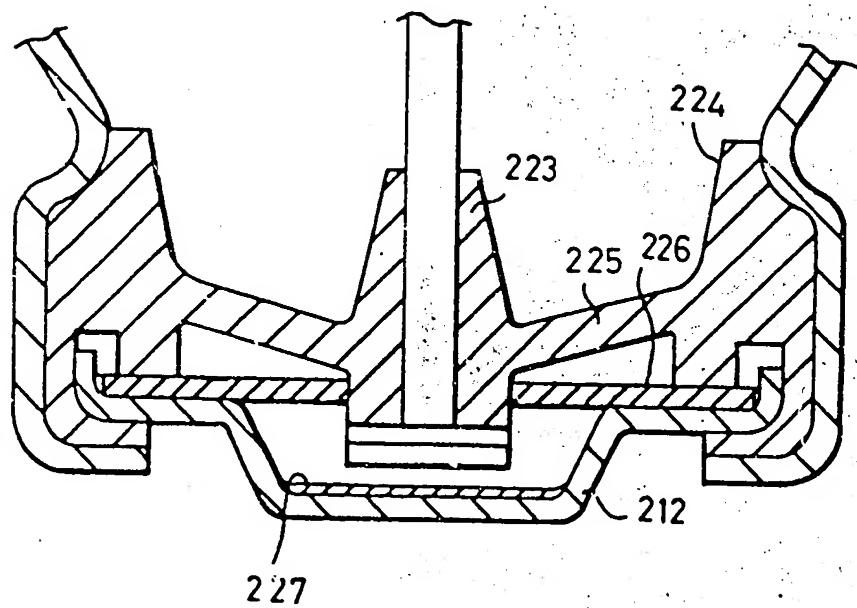
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FIG 4

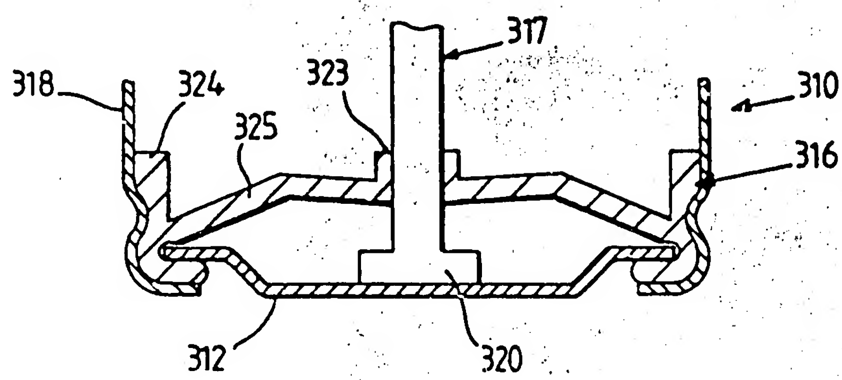

FIG 5

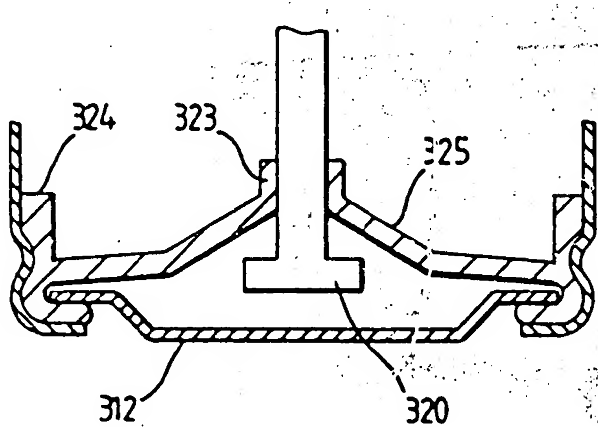

FIG 6

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"Cell"

Description of Invention

The present invention relates to a primary cell comprising a container containing at least one electrochemically active composition and current conducting means, which may include the container, providing a path for conducting electrical current through the cell. It is generally desirable for the container to be closed during manufacture of the cell and to remain closed during use of the cell. This avoids ingress of foreign matter to the container, which may interfere with proper operation of the cell, and avoids escape from the cell of material which may be harmful to persons or to equipment. It has been recognised that a permanently closed cell is potentially dangerous, because of the possibility of the generation of gas within the container. If the container is not vented, the pressure inside the container might increase to a value at which the cell is potentially dangerous.

One known solution to the problem of preventing escape of material from a primary cell during normal use, whilst avoiding risk of establishment of a dangerous pressure inside the container of the cell, is the provision of an opening from the interior of the container and closing of that opening by a seal which will yield under a moderate pressure within the container to vent the interior of the container to the ambient atmosphere. Although adoption of this solution can eliminate the risk of materials being expelled from the cell during normal use, it does not solve the problem of preventing the expulsion of materials from the cell in unusual circumstances, for example the application of reversed polarity to the cell and consequent conduction of current through the cell in a direction which is opposite to the normal direction of current flow during discharge of the cell. This can happen when a number of cells are arranged in series in apparatus and one of these cells is inadvertently placed the wrong way round.

According to the present invention, there is provided a primary cell having a container with a first wall portion which is deformed or is displaced more easily by internal pressure than is a second wall portion of the container and current conducting means providing a path for the flow of electrical current through the cell, wherein the current conducting means includes an element which is so associated mechanically with the first wall portion of the container that movement of the first wall portion relative to the second wall portion under the action of pressure within the container interrupts said path.

In the event of the pressure in a cell in accordance with the invention rising to an excessive level, the first wall portion of the container moves preferentially and this movement is used to open the electrically conductive path through the cell and thereby interrupt flow of current through the cell. This should prevent further increase in the pressure within the container. The container, or at least the first wall portion thereof, may provide a part of the electrically conductive path through the cell.

The arrangement may be such that pressure within the cell causes movement of first wall portion out of engagement with said element. Said element may be fixed to the second wall portion.

Alternatively, the element may be moved relative to the second wall portion by the action of pressure inside the container on the first wall portion.

In a further alternative arrangement in accordance with the invention, the first wall portion is excluded from the electrically conductive path through the cell and acts on said element to move the element relative to a further electrically conductive component and so open the path.

Several examples of cells embodying the invention will now be described, with reference to the accompanying drawings, wherein:-

FIGURE 1 is a diagrammatic representation of a part of a cross-section through a first cell;

FIGURE 2 is a similar diagram illustrating a second cell;

FIGURE 3 is a similar diagram illustrating a third cell;

FIGURE 4 illustrates the cell of Figure 3 after establishment in a container of the cell of an excessive pressure and opening of an electrically conductive path through the cell;

FIGURE 5 illustrates a modification of the cell of Figure 1; and

FIGURE 6 illustrates the modified cell after establishment of an excessive pressure and opening of an electrically conductive path through the cell.

The cell illustrated in Figure 1 comprises a container 10 which is of generally cylindrical form and which has at one of its ends an upper contact element 11 and its opposite end a lower contact element 12. These contact elements are formed of electrically conductive material and, when the cell is installed in equipment for use, make electrical contact with circuit components of the equipment. During use of the cell, electrical current is conducted through the cell between the elements 11 and 12.

Electro-chemically active compositions 13 and 14 are contained in the container 10 and are separated from each other by a separator 15, which is also of cylindrical form. The separator and the compositions 13 and 14 may be as used in known cells, for example cells known as manganese-alkaline cells.

A lower end portion of the container 10 comprises a disc 16 defining a central aperture through which a current collector 17 extends. The disc 16 is impermeable to the contents of the container and is a sufficiently close fit on the collector 17 to prevent escape of material from the container at the interface between the collector and the disc. The disc is formed of a resiliently deformable material, for example a thermoplastics material.

The sides of the container and the end portion of the container remote from the disc 16 are formed of metal and may be integral one with the other. The metal part engages the disc 16 at the periphery of the disc in a fluid-tight manner so that the container is closed against egress or ingress of matter, even gaseous matter. During assembly of the components of the cell, the metal part 18 of the container is deformed in a known manner to grip the disc 16 and to retain the lower contact element 12 in the assembled cell. It will be noted that the metal part 18 of the container is electrically insulated from the lower contact element and that the current collector 17 is normally held by the disc 16 in contact with the lower contact element.

The disc 16 is adapted by its shape and/or by the material of which it is formed, to deform more easily under elevated pressure in the container 10 than is the metal part 18 of the container. In the event of pressure within the container rising to an unacceptable value, that portion of the disc 16 which lies near to the collector 17 is displaced outwardly of the container

relative to the metal part 18. However, movement of the entire disc outwardly of the container is prevented by the lower contact element 12 which is fixed with respect to the metal part 18 of the container. That part of the disc 16 which is pressed against the lower contact element tends to spread both towards and away from the axis 20 of the cell.

The collector 17 includes a tapered head 20 which lies immediately adjacent to the lower contact element 12. The smaller diameter of the head is adjacent to that contact element and the larger diameter is spaced from the contact element 12. In the example illustrated, the head has a frusto-conical surface which is engaged by a complimentary surface of the disc 16. When that portion of the disc which is pressed against the lower contact element 12 spreads towards the axis 19, it acts as a wedge to drive the head 20 away from the contact element 12 and thereby open the electrically conductive path through the cell. This renders the cell non-conducting and should prevent further increase of the pressure inside the container 10.

In the example of cell illustrated in Figure 1, there is no element acting on the collector 17 to urge the collector towards the lower contact element 12 after these components have been separated by the wedging action of the disc 16. Accordingly, once the electrically conductive path through the cell has been opened at the interface between the collector and the contact element 12, the path will remain open. The cell is of no further use and will be discarded. It will be noted that the limited deformation of the container 10 which results in opening of the electrically conductive path through the cell does not result in venting of the cell. The container remains closed.

The cell illustrated in Figure 2 comprises certain parts which correspond to parts of the cell already described with reference to Figure 1. In Figure 2, such corresponding parts are identified by like reference numerals with the prefix 1 and the preceding description is deemed to apply, except for differences hereinafter mentioned. The current collector 117 of the cell shown in Figure 2 has a head 120 but this head underlies a central part of the disc 116, rather than being disposed in an opening of the disc. A stiff washer 121 is interposed between the head 120 and the disc 116, to distribute over a substantial area of the disc force acting between the disc and the head of the current collector. The washer 121 is conveniently formed of a metal and has only a mechanical function. The washer 121 is preferably received in a well defined by the disc 116 and the side wall of the well may have one or more projections past which the washer 121 is forced, during

assembly of the washer with the disc 116, the projection or projections thereafter retaining the washer in assembled relation with the disc.

The current conducting means of the cell shown in Figure 2 includes a disc spring 122 which is interposed between the head 120 of the current collector and the lower contact element 112 of the cell. The disc spring has two stable configurations, one in which the spring is downwardly concave and the other in which the spring is downwardly convex. The cell is assembled with the disc spring 122 downwardly concave and the disc spring remains in this configuration, during normal use of the cell. In this configuration, the degree of curvature of the disc spring is limited by the head 120 of the current collector. This disc spring is maintained under stress between the current collector and the lower contact element 112 so that the disc spring engages both of these components under substantial pressure.

That portion of the disc 116 which overlies the washer 121 is thin, relative to that portion of the disc which lies radially outwardly of the washer. The disc 116 is formed of a resiliently deformable material, for example polypropylene and the central portion of the disc deforms more easily than the peripheral portion of the disc. When the pressure inside the container 110 increases to an excessive value, the disc 116 is deformed so that the central portion thereof moves along the axis 119 in a direction outwardly of the cell, relative to the peripheral portion of the disc, which is fixed with respect to the metal portion 118 of the container. The current collector 117 and the washer 121 are carried along the axis by central portion of the disc 116 so that the disc spring 122 is stressed further. Since the disc spring 122 opposes axially outward movement of the current collector 117, the current collector and the central portion of the disc 116 continue to move axially outwardly only if there is a continuous build-up of pressure inside the cell. Eventually, the disc spring 122 is flexed sufficiently to snap into its downwardly convex configuration. In this configuration, the disc spring is spaced substantially from the head 120 of the current collector and the electrically conductive path through the cell is opened. This is expected to prevent any further increase in pressure within the container 110.

It will be noted that the cell of Figure 2 does not include any means for exerting force on the disc spring 122 in a direction to cause the disc spring to revert to its downwardly concave configuration. Accordingly, once the cell has become non-conducting, it will remain so and will be discarded.

In place of the disc-spring 122, there may be provided a spring of some other form, for example a leaf-spring.

The cell illustrated in Figures 3 and 4 also comprises parts corresponding to those hereinbefore described with reference to Figure 1. In Figures 3 and 4, such corresponding parts are identified by like reference numerals with the prefix 2 and the preceding description is deemed to apply, except for the differences hereinafter mentioned.

The head 220 of the current collector of the cell shown in Figure 3 underlies a central portion 223 of the disc 216. The central portion 223 has considerable thickness, measured along the axis 219, and is stiff, when considered in isolation from the remainder of the disc 216. A peripheral portion 224 of the disc 216 also has considerable thickness and is stiff. The peripheral portion co-operates with and is fixed with respect to the metal portion 218 of the container. The central and peripheral portions of the disc 216 are connected together by a relatively flexible, annular portion 225 which has a small thickness, relative to the thickness of the central and peripheral portions. The disc is conveniently formed of a thermo-plastic material, for example polypropylene.

The current conducting means of the cell shown in Figure 3 comprises a metal annulus 226 which provides an electrical connection between the head 220 of the current collector and the lower contact element 212. The head 220 is received with an interference fit in a cental opening of the annulus 226. This opening may be round or otherwise have a shape complementary to that of the head 220. Alternatively, in a case where the head 220 is round, the central opening of the annulus 226 may be polygonal, for example square or hexagonal, or may be of serrated or castellated shape, the annulus having a number of tongues extending into engagement with the head 220, with spaces between the tongues.

A peripheral portion of the annulus 226 is held by the lower contact element 212 in engagement with the peripheral portion 224 of the disc. As shown, the annulus 226 is preferably flat.

When there is established in the container 210 an excessively high pressure, the annular portion 225 of the disc flexes preferentially so that the central portion 223 and the current collector 217 move along the axis 219 in a direction away from the interior of the container. This movement is relative to the peripheral portion 224 and the metal portion 218 of the container. The annulus 226 is stiff, relative to the annular portion 225 of the disc, and is held

by the lower contact element 212 against movement along the axis with the current collector 217. Accordingly, outward flexing of the annular portion 225 of the disc causes the head of the current collector to move along the axis 219 relative to the annulus 226 until the head of the current collector leaves the central opening of the annulus and opens the electrically conductive path through the cell. To ensure that the electrically conductive path is not re-established by engagement of the head 220 with the lower contact element, the lower contact element may have a lining 227 of insulating material to receive the head 220. Movement of the current collector along the axis 219 is opposed by friction between the annulas 226 and the head 220.

The cell of Figure 1 may be modified as shown in Figures 5 and 6. In these figures parts corresponding to those hereinbefore described with reference to Figure 1 are identified by like reference numerals with the prefix 3 and the preceding description is deemed to apply, except for differences hereinafter mentioned.

In the modified cell of Figures 5 and 6, the central portion 323 of the disc 316 is spaced substantially from the lower contact element 312. The peripheral portion 324 of the disc is fixed with respect to the metal part 318 of the container and an intermediate portion 325 of the disc is more readily flexible than is either the central portion or the peripheral portion. This intermediate portion is arranged to bulge towards the interior of the container 310, for example being upwardly convex or having a upwardly facing apex, as shown in Figure 5. The flexibility of the intermediate portion may be increased by incorporating a joggle in the intermediate portion. In the configuration illustrated in Figure 5, the disc 316 holds the head 320 of the current collector in firm engagement with the lower contact element 312. The electrically conductive path through the cell is closed.

If the pressure inside the container 310 increases to an unacceptable level, the intermediate portion 325 of the disc is forced outwardly of the container in a direction generally along the axis 319 to adopt the configuration illustrated in Figure 6. The disc is stable in this configuration and holds the current collector 317 in a position in which it is spaced from the lower contact element 312, so that the electrically conductive path through the cell is open. The disc 316 is arranged to have a toggle action such that it snaps into the configuration of Figure 6, when deflected sufficiently from the position of Figure 5.

The material of which the disc 216 is formed and the dimensions of that disc may be selected to ensure that the deformation of the disc which is sufficient to open the electrically conductive path through the cell involves stressing of the disc beyond its elastic limit. In this case, the disc will not recover its initial shape, even if the pressure within the container 210 subsides and the electrically conductive path will remain open. Alternatively, the material and dimensions of the disc may be selected to provide that stressing of the disc within its elastic limit opens the electrically conductive path. In this case, the path may be re-closed if the pressure inside the container 210 falls.

Plastics material others that polypropylene may be used for the discs of the cells illustrated in Figures 1 to 6. Examples of such plastics materials include polyethylene, nylons and pvc. Furthermore, the discs may be formed of or incorporate an elastomer. Whilst the discs are conveniently formed of a single material, it would be within the scope of the invention to provide a composite disc, for example a disc formed partly of a thermoplastics material and partly of an elastomer.

The features disclosed in the foregoing description, or the accompanying drawings, espressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:-

1. A primary cell having a container with a first wall portion which is deformed or displaced more easily by internal pressure than is a second wall portion of the container and current conducting means for providing a path for the flow of electrical current through the cell, wherein the current conducting means includes an element so associated mechanically with the first wall portion that movement of the first wall portion relative to the second wall portion interrupts said path.

2. A cell according to Claim 1 wherein a part of said path is provided by the container.

3. A cell according to Claim 1 wherein said first wall portion is arranged for movement, under pressure from within the container, out of engagement with said element of the current conducting means.

4. A cell according to Claim 3 wherein said element is fixed with respect to the second wall portion of the container.

5. A cell according to Claim 4 wherein said first wall portion occupies an opening in a third wall portion of the container, the third wall portion is relatively easily deformable and pressure on the third wall portion from within the container forces the third wall portion between the first wall portion and said element of the current conducting means.

6. A cell according to Claim 4 wherein the first wall portion occupies an opening in a third wall portion of the container, the third wall portion is relatively easily deformable and pressure within the container deforms the third wall portion to displace the first wall portion relative to the second wall portion in a direction outwardly of the container.

7. A cell according to Claim 1 wherein said element of the current conducting means is moved relative to the second wall portion by the action of pressure inside the container on the first wall portion.

8. A cell according to Claim 7 wherein said element is a spring having two stable configurations.

9. A method of interrupting the flow of electrical current through a primary cell wherein a first wall portion of a container of the cell is moved preferentially by an increase in pressure inside the container and wherein the movement of said first wall portion is used to open an electrically conductive path through the cell.

10. A method according to Claim 9 wherein the container remains closed during and after opening of said path.

11. A method according to Claim 9 or Claim 10 wherein the movement of the first wall portion is opposed by a resilient element of the cell, which element is stessed during movement of the first wall portion.

12. A method according to Claim 11 wherein the stress in said element is at least partly relieved, when the electrically conductive path is opened.

13. A cell having a container substantially as herein described with reference to and as illustrated in Figure 1, Figure 2, Figures 3 and 4 or Figures 5 and 6 of the accompanying drawings.

14. Any novel feature or novel combination of features disclosed herein or in the accompanying drawings.

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